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Th. van de Klundert

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ABSTRACT

The concept of a dual labour market is analysed in a two-sector general equilibrium model. The primary sector pays efficiency wages, while there is no connection between efficiency and the relative wage level in the secondary sector. The two sectors produce different goods. Capital is assumed sector-specific. The log-linear version of the model is solved analytically under the condition of wage flexibility and for different forms of wage rigidity with respect to sector 2. The results may be used to explain observed differences in wage and employment distributions in the US and Europe.

1. Introduction

Labour markets in the US and Europe are different in structure. Whereas the US experienced an "employment miracle" in the eighties Europe was stuck with high unemployment rates. A possible explanation of high unemployment in a number of European countries is the relatively narrow wage distribution in these countries. This view is consistent with the observation that unemployment is heavily concentrated among low productivity groups.

Empirical evidence on characteristics of the wage structure is presented in Frijns and Van Schaaijk (1987). The authors show that the quantile ratio (Q90/Q10) of the monthly pay distribution of full-time workers in manufacturing shows a substantial difference between Europe and the US. The average ratio of male workers for seven European countries amounts to 2.1 compared with a ratio of 3.6 for the U.S. Other statistics given by Frijns and Van Schaaijk point in the same direction. With regard to the relation between employment in the low-wage brackets and the wage dispersion a distinction should be made between the <u>change</u> in wages and the <u>level</u> of relative wages. A rise in European unemployment between 1977 and 1983 of workers at the lower end of the pay structure cannot be associated with a substantial rise of the relative wage level of this category. However, there appears to be a relationship between the <u>change</u> in the unemployment rate and the relative wage <u>level</u>. A comparison of developments in the US and the Netherlands shows a strong growth of unemployment (especially at the lower wage brackets) in the country with the narrow wage distribution, in casu the Netherlands. The twin observation is that the "employment miracle" in the US may have a shadow side in the form of a more unequal pay distribution.

The dual labour market theory which has its origin in sociology (e.g. Ashton, Chapter 3, 1986) may shed some light on these issues. The idea of a dual labour market has more recently gained solid ground in economics by the introduction of a two-sector model with a union sector and a non-union sector. A brief survey of this approach is presented in Greenhalgh, et.al. (1983), Oswald (1985) and Sinclair (1987). As observed by Akerlof and Yellen (1986) dual labor markets can also be explained by the assumption that the wage-efficiency nexus is important in some sectors but not in others. Here we shall follow this suggestion by constructing a Harris-Todaro two-sector model (see Harris and Todaro, 1970). Efficiency wages are paid in the primary sector of the economy and neo-classical market-clearing of the labour market prevails in the secondary sector. In earlier formulations of the dual labour market theory the primary sector is supposed to have some control over the product market. As argued by Ashton (1986) recent research shows that the link between imperfect competition in product markets and efficiency wages is not as deterministic as suggested by older theories. It may therefore be legitimate to assume that product markets are competitive as we do here. The employment and unemployment consequences of rigid wages will be investigated by assuming a minimum wage law. If the minimum wage level is binding it may imply nominal wage rigidity or when minimum wages are indexed real wage rigidity. Moreover, we consider the possibility that real wage rigidity is accompanied by some pressure on the wage distribution. In the spirit of general equilibrium theory we assume that the sectors produce different commodities and analyse the consequences of a shift in consumers' preferences, along with other shocks to the system. Capital is considered to be sector-specific and growth factors are treated as exogenous shift parameters.

The organization of the paper is as follows. In Section 2 the micro foundations of the model are given proper attention. Efficiency wage theory in the primary sector is based on a variant introduced by Hahn (1987). To obtain neat analytical solutions, which can be easily interpreted, the log-linear version of the model is presented in Section 3. The results obtained are discussed in Section 4 with emphasis put on the factors that may influence duality. The paper closes with some conclusions.

2. A two-sector model with segmented labour markets

It will be assumed that the economy comprises two sectors with a qualitatively different output. In both sectors labour is combined with a fixed and sector-specific capital stock to produce commodities. Efficiency wages are paid in the primary sector, while in the secondary sector there is no link between remuneration and efficiency. The link between wages and labour efficiency in sector 1 is based on the adverse selection model explored among others in Weiss (1980). Here we follow a somewhat novel approach of that model introduced by Hahn (1987). Firms in sector 1 pay relatively high wages to attract workers with high ability signals for every skill group. Ability signals are things like education, experience, references etc. By assumption higher ability always implies higher productivity. To complete the picture we add the hypothesis that ability is negatively related to search cost. Therefore, the firm knows that the higher the wage paid relative to the wage level in the other sector the greater will be the proportion of workers with high ability signals applying, at least up to a certain point.

Denoting output by x, employment by ℓ, efficiency by e and capital by k the production function of sector 1 reads:

$$(2.1) \quad x_1 = f_1(e\ell_1;k_1) \quad , \quad f_1' > 0 \quad , \quad f_1'' < 0$$

, where f' and f" stand for respectively the first and second derivative of the production function with respect to labour expressed in efficiency units. As argued, efficiency is positively related to the wage differential. Denoting the nominal wage rate in sector 1 by w_1 and in sector 2 by w_2 the efficiency function can be written as

$$(2.2) \quad e = e(\frac{w_1}{w_2}) \quad , \quad e(0) < 0 \quad , \quad e' > 0 \quad , \quad e'' < 0$$

The efficiency function has the usual characteristics, which guarantee an interior solution in case of profit maximization (cf. Akerlof, 1982): (1) no positive effort is obtained at a zero wage; (2) the elasticity of e with respect to w_{1/w_2} is declining for an increasing wage ratio.

With the price of output (p_1) and the nominal wage rate in sector 2 (w_2) given the representative firm in sector 1 faces the following problem:

$$\underset{\{\ell_1, w_1\}}{\text{Max}} \quad \pi = p_1 f_1(e\ell_1 \; ;k_1) - w_1\ell_1$$

subject to equation (2).

The first-order conditions for this problem are

(2.3) $\quad p_1f_1' = \frac{w_1}{e}$

(2.4) $\quad p_1f_1' = \frac{w_2}{e'}$

Combination of equations (3) and (4) yields the familiar "Solow condition"

(2.4a) $\quad \frac{e'}{e}\frac{w_1}{w_2} = 1$

For an optimum the elasticity of the efficiency function should be equal to unity (Solow, 1979). With w_2 given the nominal wage rate in sector 1 can be found from this equation. Substitution of the optimal value of w_1 in equation (2.2) gives the optimal level of efficiency. The outcome for e can be substituted in equation (2.3) to obtain the level of employment ℓ_1.

In the secondary sector efficiency wages play no role; the wage-productivity relationship is weak or non-existant. Consequently, the demand for labour in sector 2 depends upon the wage, which is determined in the spot market for secondary jobs. The production function for sector 2 is

(2.5) $\quad x_2 = f_2(\ell_2;k_2) \quad , f_2' > 0 \quad , f_2'' < 0$

Maximization of profits in the short run requires that marginal revenu equals marginal labour cost. With p_2 and w_2 given this condition can be written as

(2.6) $\quad p_2f_2' = w_2$

The aggregate supply of labour (ℓ_s) is exogeneously determined. Worker who cannot find a job in the primary sector apply for work in the secondary sector. The wage rate in sector 2 can be found by equating labour supply and labour demand in this sector:

(2.7) $\quad \underline{\ell}_s - \ell_1 = \ell_2$

For a given value p_2 equations (2.7) and (2.8) simultaneously determine the wage rate and employment in the secondary sector.

The mobility of labour between sectors may not be so perfect as assumed here. After all, there may be a substantial wage differential and there is rationing of jobs in the primary sector. Therefore, as observed among others by Hall (1975), Akerlof and Yellen (1986) and in another context also by McDonald and Solow (1985), workers who do not get a job in sector 1 could prefer searching above accepting work in the secondary sector. The search process can be modelled if a number of additional assumptions is made. But the question remains whether search is compatible with an equilibrium. To illustrate this point consider the following case which greatly simplifies the search model in McDonald and Solow (1985). There is a fixed percentage of jobs ($\delta \ell_1$) in the primary sector which will open up in (continuous) time, because people die, retire, quit, etc. All vacancies are filled from a transitional pool (ℓ_p) consisting of workers in search for a job in sector 1. The probability of finding a job, if numbers are large enough so that frequencies and probabilities can be identified, is then $\xi = \frac{\delta \ell_1}{\ell_p}$. Under static expectations lifetime income of persons in the pool equals: $(\xi\, w_1 + (1-\xi)v)/r$, where v is unemployment compensation and r is a discount rate. If workers are risk-neutral this option should be equal to lifetime income from working in the secondary sector (w_2/r):

$$\frac{\xi\, w_1 + (1-\xi)v}{r} = \frac{w_2}{r}$$

Substituting the formula for the probability of finding a primary job gives after some manipulation:

$$\ell_p = \delta \ell_1 \left[\frac{w_1 - v}{w_2 - v}\right]$$

The volume of the pool is positively related to the number of primary jobs, the turnover rate of these jobs, the wage differential and unemployment compensation. However, one may doubt whether this theory gives a complete picture. First, people not only die but also get born. A part of

the jobs coming available in the primary sector may go to new entrants in the labour market. Second, there is the chance of a direct transmission of workers from sector 2 to sector 1 despite a lower search intensity of the employed. Third, workers may be risk-averse and the risk of not finding a primary sector job may increase when staying longer in the pool.
For these reasons we shall ignore search and stick to the labour supply equation (2.7) in our subsequent analysis.

The model must be closed by introducing demand. All income is flowing to consumers. The representative household maximizes utility, which depends on quantities consumed of both goods, subject to the usual budget constraint. To make the analysis tractable it is assumed that the utility function is of the Cobb-Douglas type. The share of income spent on each commodity is therefore constant. Denoting quantities consumed by the same symbol as quantities produced, that is postulating equilibrium in both markets, we may write,

(2.8) $p_1 x_1 = \alpha y$

, where y is total income:

(2.9) $y = p_1 x_1 + p_2 x_2$

Finally, the nominal level of prices is determined by a simple quantity equation:

(2.10) $y = \nu M$

, where M indicates a given quantity of money.

The complete model comprises the equations (2.1) - (2.10), which can be solved for the endogenous variables, viz., x_1, x_2, ℓ_1, ℓ_2, e, w_1, w_2, p_1, p_2 and y. The solution is illustrated in a diagram which is well-known from the theory of international trade (e.g. Dixit and Norman, 1980, chapter 2). In Figure 1 the nominal wage rate in sector 1 is measured among the vertical axis to the left.

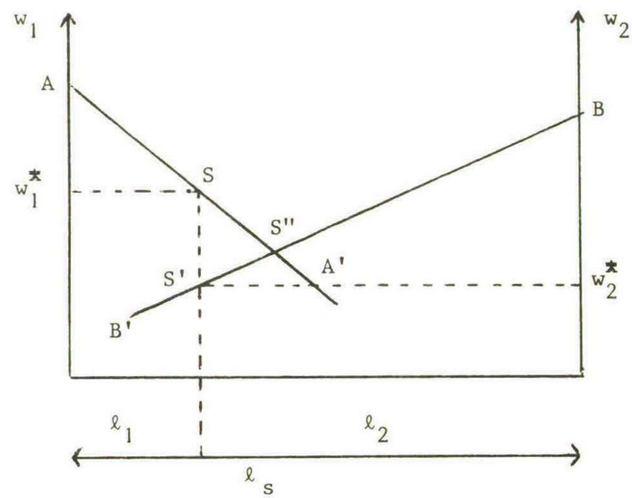

Figure 1

The curve AA' measures the demand for labour in sector 1 given the equilibrium values e^* and p_1^*. The nominal wage rate in sector 2 is measured along the vertical axis to the right. The demand for labour (ℓ_2) at the equilibrium price p_2^* is given by the curve BB' which runs from the right to the left. The distance between the vertical axes is equal to the total supply of labour ℓ_s. The curves are linear for illustrative reasons only. Firms in sector 1 choose point S on the demand curve for labour AA' given the wage rate in sector 2. The wage rate in sector 2 is determined by supply and demand given the amount of labour employed in sector 1. The solution is shown in point S' on the curve BB'. It should be observed that a solution always lies to the left of the point of intersection (S") of the curves AA' and BB'.

If the government sets a minimum wage above the level that results from the free play of market forces as may be typical for a number of European countries there will be unemployment. The same result applies in case unemployment benefits lead to a reservation wage of workers which is higher than the equilibrium wage rate in the secondary sector. The solution in these cases is presented in Figure 2. The minimum wage level is indicated by $\underline{w}_2$. Given this wage rate in the secondary sector firms in the primary sector choose an optimal w_1 and ℓ_1 at point S. Labour supply in

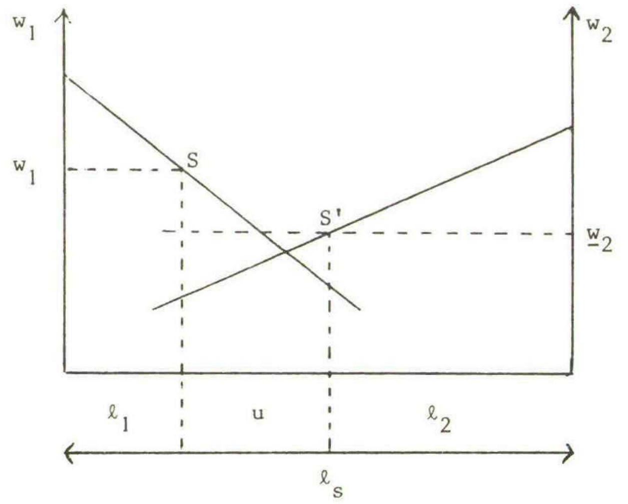

Figure 2

sector 2 is elastic at the point $w_2 = \underline{w}_2$. Employment in the secondary sector is determined at the intersection of the elastic supply curve and the labour demand curve of that sector (point S'). The resulting unemployment is marked by u in Figure 2. If the discrepancy between primary and secondary sectors is substantial there may be a large number of low-paid workers in the equilibrium. That is the price that has to be paid for maintaining full-employment with a relative large secondary sector. Such a solution seems more typical for the US than for Europe where relative poverty may be transformed into unemployment by a generous social security system and minimum wage legislation.

The figures illustrating solutions in case of a dual labour market are merely instructive. To understand the model more fully an algebraic solution must be given. For this purpose a log-linear version of the model will be discussed next. Such a linear version is well-suited for simple comparative statics when variables are cast in the form of rates of change.

3. The linear version of the model

The model may be linearized by deriving logarithmic approximations of the functional forms at an initial solution. Differentiation of the log-version which respect to time gives a linear model in rates of change, which are indicated by a dot over the variable (for instance $\dot{x} = \frac{dx}{dt}\frac{1}{x}$).

The linear equivalent of the production function (2.1) can be written as

$$(3.1) \qquad \dot{x}_1 = \beta_1(\dot{e}+\dot{\ell}_1) + (1-\beta_1)\dot{k}_1$$

, where β_1 denotes the share of labour in value-added of the primary sector at the initial solution. Linearization of the effort function (2.2) needs more explanation. An example of a function with the required proporties is given in Akerlof (1982):

$$e = -a + b\left[\frac{w_1}{w_2}\right]^{\gamma} \quad , \gamma < 1$$

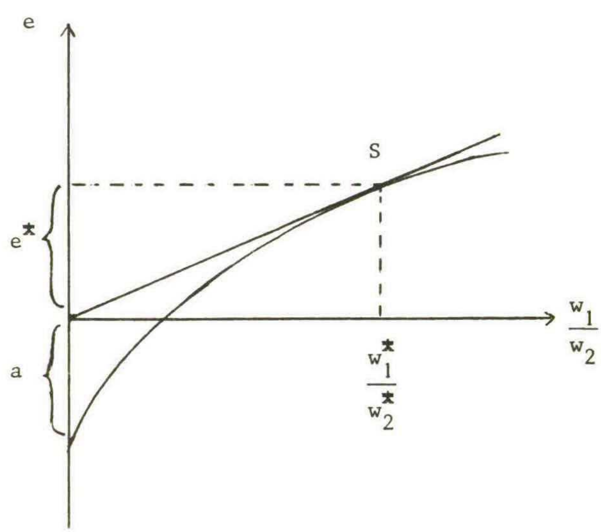

Figure 3

The function is shown in Figure 3. Differentiation with respect to time and assuming that b and γ are constant results in

$$\frac{de}{dt}\frac{1}{e} = -\frac{a}{e^*}\frac{da}{dt}\frac{1}{a} + \gamma b \left[\frac{w_1^*}{w_2^*}\right]^{\gamma} \left(\frac{dw_1}{dt}\frac{1}{w_1} - \frac{dw_2}{dt}\frac{1}{w_2}\right)$$

, where initial solutions are marked with an asteriks. To simplify the above expression parameters may be given the following values: $\gamma = \frac{1}{2}$, $a = e^*$. The linear version of the effort function reads in this case:

$$(3.2) \qquad \dot{e} = (\dot{w}_1 - \dot{w}_2) - \dot{a}$$

The second term on the RHS of equation (3.2) relates to vertical shifts of the effort function. An upward shift ($\dot{a} < 0$) means that firms in sector 1 can afford to pay lower relative wages to get the same efficiency level as before. This may be interpreted as a qualitative improvement of the labour force, so that firms in the primary sector can hire workers with the right ability signs more easily. The linearization procedure can be applied in a similar way to a more general effort function with the required characteristics such as the one illustrated in Figure 3.

As shown for instance in Van de Klundert (1983), Bruno and Sachs (1985) the linear version of the equation of the demand for labour in efficiency units (2.3) can be expressed in the following way:

$$(3.3) \qquad \dot{e} + \dot{\ell}_1 = -\frac{\sigma_1}{1-\beta_1}(\dot{w}_1 - \dot{e} - \dot{p}_1) + \dot{k}_1$$

, where σ_1 denotes the elasticity of factor substitution in the primary sector. The other first-order condition taken into consideration for linearization is the Solow condition (2.4a). Differentiation of this equation with respect to time gives:

$$e' \frac{d\, w_1/w_2}{dt} + \frac{w_1^*}{w_2^*} e'' \frac{d\, w_1/w_2}{dt} = \frac{de}{dt}$$

Dividing through by e and substituting (2.4a) results in:

$$(\dot{w}_1-\dot{w}_2) + \frac{w_1^*}{w_2^*}\frac{e''}{e'}(\dot{w}_1-\dot{w}_2) = \dot{e}$$

, which can be rewritten as

$$(3.4) \quad \dot{w}_1 - \dot{w}_2 = \frac{\dot{e}}{1-\psi}, \qquad \text{with } \psi \equiv -\frac{w_1^*}{w_2^*}\frac{e''}{e'} \quad , 0 < \psi < 1$$

The elasticity of marginal effort (ψ) must be smaller than one, because the elasticity of the effort function must be declining (e.g. Akerlof, 1982). In the case of the specification of this function given above we get $\psi = 1 - \gamma$.

The linear version of the production function and the demand for labour in sector 2 are obtained easily. From equation (2.5) we have:

$$(3.5) \quad \dot{x}_2 = \beta_2 \dot{\ell}_2 + (1-\beta_2)\dot{k}_2$$

, where β_2 denotes the share of labour in value-added of sector 2. Equation (2.6) yields the linear labour demand relation in the secondary sector:

$$(3.6) \quad \dot{\ell}_2 = -\frac{\sigma_2}{1-\beta_2}(\dot{w}_2-\dot{p}_2) + \dot{k}_2$$

, where σ_2 denotes the elasticity of factor substitution in sector 2. Labour-market equilibrium implies according to equation (2.7):

$$(3.7) \quad \vartheta\dot{\ell}_1 + (1-\vartheta)\dot{\ell}_2 = \dot{\ell}_s$$

, where ϑ is the share of labour in the primary sector at the point of linearization.

On the demand side of the model account will be taken of a shift in demand from goods produced in sector 2 towards goods produced in sector 1. As a consequence the linear version of equation (2.8) may be written as

$$(3.8) \quad \dot{p}_1 + \dot{x}_1 = \dot{y} + \dot{\alpha}$$

Applying the linearization procedure to equation (2.9) results in

$$(3.9) \quad \dot{y} = \lambda(\dot{p}_1+\dot{x}_1) + (1-\lambda)(\dot{p}_2+\dot{x}_2)$$

, where λ denotes the share of expenditure with respect to sector 1 at the point of linearization. Finally, the linear version of the quantity equation (2.10) reads

$$(3.10) \quad \dot{y} = \dot{M}$$

The complete linear model comprising ten equations with the same number of endogenous variables can easily be solved. The solutions will be discussed in the next section.

4. Wages differentials, sectoral employment and unemployment

The nominal wage ratio is set by profit maximizing firms in the primary sector. Combining equations (3.2) and (3.4) one gets:

$$(4.1) \quad \dot{w}_1 - \dot{w}_2 = \frac{\dot{a}}{\psi}$$

$$(4.2) \quad \dot{e} = \frac{1-\psi}{\psi}\dot{a}$$

An increase in the shift variable worsens the labour market situation for firms in the primary sector, so that a higher relative wage rate must be paid to obtain the same efficiency level as before the change. The equilibrium efficiency level increases because $\psi < 1$ holds.

From equations (3.1), (3.3), (3.8) and (3.10) the following expression for employment in the primary sector can be derived

$$(4.3a) \quad \dot{\ell}_1 = \frac{1}{1-\beta_1(1-\sigma_1)}[-\sigma_1(\dot{w}_1-\dot{M}-\dot{\alpha}) + (1-\beta_1)(1-\sigma_1)(\dot{k}_1-\dot{e})]$$

A similar result can be found for employment in sector 2 by using equations (3.5), (3.6), (3.8), (3.9) and (3.10).

$$(4.4a) \quad \dot{\ell}_2 = \frac{1}{1-\beta_2(1-\sigma_2)} [-\sigma_2(\dot{w}_2-\dot{M} + \frac{\lambda}{1-\lambda} \dot{\alpha}) + (1-\beta_2)(1-\sigma_2)\dot{k}_2]$$

As appears from the semi-reduced forms (4.3a) and (4.4a) things can be simplified considerably by assuming that production functions are of the Cobb Douglas type, that is assuming $\sigma_1 = \sigma_2 = 1$. Elasticities of substitution close to one are found in a number of empirical studies, which makes this approximation acceptable. The solutions for employment in both sectors are then easily obtained bearing equations (3.7), (4.1), (4.3a) and (4.4a) in mind.

$$(4.3) \quad \dot{\ell}_1 = \dot{\ell}_s - \frac{(1-\vartheta)}{\psi} \dot{a} + \frac{1-\vartheta}{1-\lambda} \dot{\alpha}$$

$$(4.4) \quad \dot{\ell}_2 = \dot{\ell}_s + \frac{\vartheta}{\psi} \dot{a} - \frac{\vartheta}{1-\lambda} \dot{\alpha}$$

Equations (4.3) and (4.4) give rise to a number of interesting observations. An improvement in the effort function ($\dot{a} < 0$) raises employment in the primary sector and lowers employment in the secondary sector. Such an improvement may be the result of a better education of the labour force, which makes it easier for firms in the primary sector to attract workers will high ability signals. An increase in the labour force ($\dot{\ell}_s > 0$) leads to a proportional rise in employment in both sectors, which is understandable because the nominal wage ratio does not change. However, if a mutation in the supply of labour is accompanied by a change in the qualitative composition of the labour force this result does not hold. For instance, an inflow of relatively less educated workers will make it more difficult for firms in sector 1 to maintain their share in total employment. Therefore, it must be concluded that the effort function will deteriorate ($\dot{a} >$ 0), leading to a shift in employment from the primary to the secondary sector. As a result the bulk of the increase in labour supply must be absorbed in the secondary sector.

A similar reasoning applies in the case of a shift in demand. A shift towards the primary sector ($\dot{\alpha} > 0$) raises employment in that sector at the expense of employment in sector 2, as follows from equations (4.3) and (4.4). Such a reallocation of labour may not be possible without affecting the effort function. To attract additional workers with the same efficiency level as the employed workers firms in the primary sector may have to increase the wage differential. Such a change in opportunities may eventually prevent a reallocation of labour on impact of a change in demand for commodities. The upshot of this discussion is that the effort function may not be invariant to changes in the parameters or exogenous variables of the model. As a specification of the effort function which takes such complications properly into account is difficult comparative statics conclusions should be formulated with the required cautiousness. Returning to equations (4.3) and (4.4) it should be observed that a change in the capital stock of a sector does not affect employment in that sector. Under the Cobb-Douglas assumption the positive direct effect on employment of an increase in capital is counterbalanced by the negative indirect effect of an increase in the real producers' wage.

To study the effect of different shocks on the purchasing power of wages in different sectors we first define the consumers' price index in the usual way as:

$$(4.5) \qquad \dot{p}_c = \lambda \, \dot{p}_1 + (1-\lambda)\dot{p}_2$$

The real consumers' wage for both sectors can then be expressed in following manner:

$$(4.6) \qquad \dot{w}_1 - \dot{p}_c = \dot{w}_1 - \dot{p}_1 + (1-\lambda) \; (\dot{p}_1-\dot{p}_2)$$

$$(4.7) \qquad \dot{w}_2 - \dot{p}_c = \dot{w}_2 - \dot{p}_2 - \lambda(\dot{p}_1-\dot{p}_2)$$

The real producers' wage in both sectors can be found by substituting equation (4.3) in equation (3.3) and by substituting equation (4.4) in equation (3.6) taking the assumption $\sigma_1 = \sigma_2 = 1$ into account.

$$(4.8)\quad \dot{w}_1 - \dot{p}_1 = (1-\beta_1)\,[(\dot{k}_1-\dot{\ell}_s) - \frac{(1-\vartheta)}{1-\lambda}\,\dot{\alpha}] + \frac{(1-\vartheta) + \beta_1(\vartheta-\psi)}{\psi}\,\dot{a}$$

$$(4.9)\quad \dot{w}_2 - \dot{p}_2 = (1-\beta_2)\,[(\dot{k}_2-\dot{\ell}_s) - \frac{\vartheta}{\psi}\,\dot{a} + \frac{\vartheta}{1-\lambda}\,\dot{\alpha}]$$

The relative price of commodities can be derived after some manipulations as:

$$(4.10)\quad \dot{p}_1 - \dot{p}_2 = (\beta_2-\beta_1)\dot{\ell}_s + (1-\beta_2)\dot{k}_2 - (1-\beta_1)\dot{k}_1 + \frac{(\beta_2\vartheta - \beta_1(\vartheta-\psi))}{\psi}\,\dot{a} + \frac{1-\beta_1(1-\vartheta)-\beta_2\vartheta}{1-\lambda}\,\dot{\alpha}$$

The following simplifying assumptions which relate to the solution of the model at the point of linearization are made: $\beta_1 = \beta_2 = \beta$, $\vartheta = \psi$. In addition we postulate $\dot{k}_1 = \dot{k}_2 = \dot{k}$. Although these assumptions may seem rather restrictive, they enable to focus on the main determinants of sectoral real wages in terms of the composite consumption good. The real consumers' wage for both groups of workers can then be deduced from equations (4.6) - (4.10).

$$(4.11)\quad \dot{w}_1 - \dot{p}_c = (1-\beta)\ (\dot{k}-\dot{\ell}_s) + [\frac{1-\vartheta}{\psi} + (1-\lambda)\beta]\ \dot{a} + \frac{(1-\beta)(\vartheta-\lambda)}{1-\lambda}\,\dot{\alpha}$$

$$(4.12)\quad \dot{w}_2 - \dot{p}_c = (1-\beta)(\dot{k}-\dot{\ell}_s) - [(1-\beta) + \lambda\beta]\ \dot{a} + \frac{(1-\beta)(\vartheta-\lambda)}{1-\lambda}\,\dot{\alpha}$$

A change in the relative factor abundance has a proportionate effect on the purchasing power of workers provided that the initial share of labour is the same in both sectors. If labour becomes more abundant the real consumers' wage of workers in the primary and in the secondary sector falls by the same percentage. A shift in demand for commodities has under these assumptions a uniform effect on the real consumers' wage of both groups of employers. A higher preference for goods of the primary sector increases the purchasing power of workers if $\vartheta > \lambda$, that is if there is a labour-intensity bias with respect to the primary sector. A deterioration of the wage-effort relationship in sector 1 ($\dot{a} > 0$) induces a higer real consumers' wage in the secondary sector. A worsening of employment conditions in the primary sector could be the result of a divergent development between the qualitative input requirements at the one hand and the availability of workers with the right abilities on the other hand. In such a pessimistic growth scenario duality would become more pronounced. More workers would have to be employed in the secondary sector at a lower real wage rate, at least compared with employees in the primary sector.

An unequal distribution of labour income may lead to government intervention in the form of minimum wage legislation. This could imply nominal (downward) wage rigidity (NWR) on real (downward) wage rigidity (RWR). The case of NWR is rather simple. For $\dot{w}_2 = 0$ the solution of $\dot{w}_1$ follows immediately from equation (4.1). Substitution of these results in equations (4.3ε) and (4.4a) ignoring now shifts in consumer demand yields when the production functions are Cobb-Douglas:

$$(4.13) \quad \dot{\ell}_1 = \dot{M} - \frac{1}{\psi}\dot{a}$$

$$(4.14) \quad \dot{\ell}_2 = \dot{M}$$

Under the condition that in the initial situation the supply of labour exceeds the demand for labour relative changes in (un)employment (ℓ_d) are given by:

$$(4.15) \quad \dot{\ell}_d = \vartheta\,\dot{\ell}_1 + (1-\vartheta)\dot{\ell}_2 = \dot{M} - \frac{\vartheta}{\psi}\dot{a}$$

An adverse development affecting the wage-effort relationship in the primary sector now leads to an increase in unemployment. Firms in the secondary sector will not absorb the excess labour of the primary sector at the going wage rate in sector 2. However, because <u>nominal</u> wages in sector two are rigid the monetary authorities could inflate the economy out of the unemployment equilibrium.

Things are more complicated when minimum wages are adjusted to the cost of living index implying:

$$(4.16) \quad \dot{w}_2 = \dot{p}_c = \lambda\,\dot{p}_1 + (1-\lambda)\dot{p}_2$$

Substitution of equations (3.1), (3.3), (3.5), (3.6), (3.9), (4.1) and (4.2) in equation (4.16) results in a solution for $\dot{w}_2$ under RWR. To get easily interpretable though still useful conclusions we again introduce a number of simplifying assumptions, i.e. $\sigma_1 = \sigma_2 = 1$, $\beta_1 = \beta_2 = \beta$, $\dot{k}_1 = \dot{k}_2 = \dot{k}$ and $\dot{\alpha} = 0$. The solution for the nominal wage rate in sector 2 then reads:

$$(4.17) \quad \dot{w}_2 = \dot{M} + \frac{\lambda\beta}{1-\beta}\dot{a} - \dot{k}$$

The outcome for the nominal wage rate in the primary sector follows from equations (4.1) and (4.17)

$$(4.18) \quad \dot{w}_1 = \dot{M} + \left(\frac{\lambda\beta}{1-\beta} + \frac{1}{\psi}\right)\dot{a} - \dot{k}$$

Employment in both sectors can be found by combining equations (4.17) - (4.18) and equations (4.3a) - (4.4a) bearing the simplifying assumptions made earlier in mind. The results can be used to define the percentage change in (un)employment as:

$$(4.19) \quad \dot{\ell}_d = \vartheta\,\dot{\ell}_1 + (1-\vartheta)\dot{\ell}_2 = -\left[\frac{\lambda\beta}{1-\beta} + \frac{\vartheta}{\psi}\right]\dot{a} + \dot{k}$$

A deterioration of the wage-efficiency conditions in the primary sector is translated into higher unemployment. Under RWR the effect is greater than under NWR as appears when comparing equations (4.15) and (4.19). A loss in efficiency in sector 1 induces a rise in the price of good 1. The wage rate of workers in sector 2 will rise to stabilize their purchasing power. The ultimate result will be a higher level of unemployment as more workers in the secondary sector lose their job. Money is neutral under RWR, but capital accumulation has a positive effect on employment. With NWR and Cobb-Douglas production functions an increase in the stock of capital has no influence on employment, because production rises through capital deepening. If relative prices and real wages are fixed as in the case of RWR production increases on account of capital widening.

It should be observed that RWR as such does not imply a change in the wage structure. Equation (4.1) still holds. However, it could be the case that RWR does go hand in hand with a levelling of the wage distribution. If this occurs the Solow condition (3.4) should be replaced by

$$(4.20) \quad \dot{w}_1 = \dot{w}_2 - \dot{q}$$

, where q is an exogenous shift variable affecting the wage structure. Under these circumstances firms are not longer in a position to maximize profits as they have to accept an autonomous reduction in labour efficiency:

$$(4.21) \quad \dot{e} = -\frac{1}{\gamma}\dot{q} \quad , \quad \gamma < 1$$

The change in employment in both sectors can now be calculated along the lines set out earlier for the case of RWR. (The simplifying assumptions made above hold and additionally we assume $\gamma = \frac{1}{2}$).

$$(4.22) \quad \dot{\ell}_1 = (1 - \frac{\lambda\beta}{1-\beta})\,\dot{q}$$

$$(4.23) \quad \dot{\ell}_2 = - \frac{\lambda\beta}{1-\beta}\,\dot{q}$$

, which gives:

$$(4.24) \quad \dot{\ell}_d = (\vartheta - \frac{\lambda\beta}{1-\beta})\dot{q}$$

Employment in the primary sector may rise or fall depending on the values of the parameters β and λ. For $\lambda = \frac{1-\beta}{\beta}$ employment in sector 1 is constant and aggregate employment changes by : $\dot{\ell}_d = -(1-\vartheta)\dot{q}$. Labour demand in the secondary sector declines on any account. These results can easily be explained. In the primary sector the loss in efficiency is to a certain extent counterbalanced by the fall in real producers' wages. The outcome may go either way. Moreover, the decline in efficiency leads to a rise in p_1 and therefore to a reduction in purchasing power for which workers in sector 2 get compensation. Real consumers' wages in sector 2 remain constant, but real producers' wages increase as can be seen from equation (4.7). It may be concluded that a more narrow distribution of wages is accompanied by a higher level of unemployment of relatively low-productivity workers.

5. Conclusions

The growing concern about poverty in the midst of plenty in industrialized countries may be an indication of a more pronounced duality in the economy with important consequences for the labour market. If primary sector jobs get lost because a more sophisticated production process requires relatively more workers with high ability the secondary sector must absorb more labour. This will lead to a more unequal real wage distribution between workers in both sectors. A growth in the labour force will have a similar effect if it upsets the productivity distribution as may be the case with immigration from developing countries.

Whereas such developments may prevail in the US, the situation in Europe is different. Minimum wage legislation and generous unemployment compensation in a number of European countries may set a floor to the wage rate in the secondary sector. An intensification of duality will then show up in increased unemployment of low-productivity groups. The problem is most severe with real wage rigidity in the secondary sector. In the latter case monetary policy is of no help and unemployment must be fought by supply-side measures.

Future research on the dual labour market may focus on the specification of the efficiency-wage relationship in different sectors of the economy. In addition, a distinction could be made between groups of workers with different skills, which are imperfect substitutes in the production process. As in the present paper general equilibrium theory can be applied to integrate these different strands of analysis.

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